IRREGULAR MESH AND EMBEDDED GEOMETRIC DESCRIPTION IN A COMPUTER GRAPHICS SYSTEM

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FIELD OF THE INVENTION

The present invention relates generally to computer graphics, and topological and geometrical representation of 3-dimensional objects. More particularly the invention relates to description of objects using meshes.

BACKGROUND OF THE INVENTION

Representations of 3-dimensional objects in computer graphics are often based on the creation of some kind of mesh consisting of vertices connected by edges and faces. This mesh creates a frame upon which surfaces and texture can be superimposed. Such a model has two distinct, but interrelated, properties, namely the topology, which is a description of how the various vertices are connected by edges and faces, and the geometry, which is the position in space of the vertices and the shape of the surface superimposed on the mesh.

Boundary based representation of objects (B-rep) has been exploited for a number of years within such fields as Computer Aided Design (CAD), modeling of geological structures, and entertainment such as games and movies. B-reps represent objects by their boundaries. For example, a 3D cube is represented by its six faces, where the faces are tied together with some relationship information. An object is usually subdivided further, such that volumes, faces, edges and vertices are represented explicitly, along with the positional relationships between these entities. The various B-rep based topological representations differ in their level of subdivision, the relationships established between the topological elements, and how they distinguish between the topological model and the data embedded in this model, e.g. geometry.

Subdivision is a technique wherein a mesh is successively refined by repeated subdivision. A smooth surface is defined as the limit of a sequence of such refinements. Subdivision allows arbitrary topology, but the topology has not been explicitly defined in prior art solutions. One example of how topology has been handled is in the form of lists, and in order to e.g. find the neighbors of a given face in the mesh, it would be necessary to traverse the entire lists.

An alternative approach has been to use a regular mesh and associate a spline patch with each face. A refinement of this method, known as hierarchical B-splines, involves refining the mesh locally and adding smaller patches to the refined area. Again, this method lacks any explicit data model representing the topology.

Various representations can be chosen for the geometric entities embedded in the topological model. At a simplest level, straight lines are used to describe curves